

WHAT IS CLAIMED IS:

31. A method of geophysical exploration comprising:

2 imparting a plurality of modes of seismic energy into the
3 earth's subsurface formations with a seismic energy source, each
4 imparting of a mode of seismic energy by the seismic energy
5 source constituting a seismic event;

6 detecting seismic energy from the seismic events with a
7 plurality of seismic receivers, the seismic receivers adapted to
8 detect seismic energy in at least two different orientations;

9 recording seismic traces corresponding to the detected
10 seismic energy;

11 transforming the seismic energies produced by the seismic
12 energy source to energies in a plurality of transformed modes;
13 and

14 determining a volumetric image of the subsurface formations
15 based on the transformed seismic energies and the recorded
16 seismic traces.

32. The method of claim 31 further comprising transforming
2 the reflected energies detected by the receivers into a plurality
3 of seismic energies in a different coordinate system than that
4 received.

33. The method of claim 32 wherein the seismic events
2 detected by the receivers are transformed into modes of seismic
3 energies corresponding to radial and tangential oriented seismic
4 energies relative to an azimuth defined by a particular receiver
5 detecting the seismic events and the seismic energy source.

34. The method of claim 31 wherein the step of imparting
2 further comprises operating the seismic source in at least a
3 first and a second directional mode.

35. The method of claim 34 wherein the at least a first and
2 a second directional modes correspond to differently oriented
3 types of seismic energy

36. The method of claim 31 wherein the step of
2 transforming further comprises rotating the seismic events to a
3 radial and tangential coordinate system with respect to an
4 azimuth defined between any receiver detecting the seismic event
5 and the seismic energy source.

37. The method of claim 31 wherein the step of determining
2 is performed at least in part with any seismic event transformed
3 to a radial and tangential coordinate system with respect to a

4 receiver detecting the seismic event and the seismic energy
5 source.

38. The method of claim 31 wherein the different orientations
2 are orthogonal to one another.

39. A method of geophysical exploration comprising:
2 imparting seismic energy into a subsurface formation of the
3 earth with a plurality of modes of seismic events from a seismic
4 energy source;

5 detecting each seismic event with at least one receiver, the
6 at least one receiver adapted to detect seismic energy from a
7 seismic event in a plurality of orientations;

8 transforming the plurality of modes of seismic events produced
9 by the seismic energy source to seismic energies in plurality of
10 transformed modes;

11 discriminating a plurality of orientations of detected seismic
12 energies from the detected seismic events;

13 determining a volumetric image of the subsurface formation of
14 the earth based on the transformed seismic events and the
15 discriminated detected seismic energies.